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Engineer Research and Development Center

Method to Evaluate Potential for Ice Impacts on Sediment Stability

Problem

Uncertainty surrounding ice and sediment interaction introduces a high-level risk in the design of contaminated sediment remediation measures in rivers. Because much of the historic industrial activity in the United States is concentrated along northern rivers, many contaminated sediment sites are ice-affected. Furthermore, a high level of design uncertainty and risk results from a lack of adequate analytical or numerical models to predict sediment transport under ice covers. Significant amounts of contaminated sediment can pose potential risk to habitat and human health.

The presence of ice has a range of possible influences on the sediment regime. A floating ice cover can dramatically increase turbulent shear stress on the bed, thereby causing peak annual sediment-transport events for northern rivers to occur during the dynamic breakup of an ice cover or the release of a breakup ice jam. These events often involve high discharges, with gouging and abrasion of the bed and banks by moving ice. Ice in a river channel can reduce the flow area, increasing under-ice water velocity, scouring bed sediments, and possibly shifting the path of the deepest flow. Ice accumulations also may impinge flow against the channel sides, thus contributing to bank erosion.

This ice jam, which occurred in 2003 on the Androscoggin River in Maine, caused overbank flooding and sediment deposition.

Description

ERDC is conducting ongoing research to develop reliable analytical and numerical models to better understand scour-under-ice issues and thereby predict sediment movement under ice. Researchers evaluate ice effects on sediment processes by analyzing available meteorological and stream flow data, correlate that data with information on historic ice events and analyses of hydrometeorological and geomorphic data, and perform field inspections to observe signs of past ice damage to river banks, structures, or riparian vegetation.

Expected Products

Initially, this research will provide a practical method to assess ice jam occurrence and evaluate potential for ice-related impacts on sediment stability. The primary objectives of the method are to determine if and where ice events occur, and whether or not these events affect sediment stability at locations of interest. Later research will develop guidance and methods for detailed analysis of ice impacts on sediment stability.

Potential Users

The results of this research will be used by engineers and scientists for Corps of Engineers Districts and partners (e.g., Environmental Protection Agency, other Federal agencies, state environmental protection agencies) who are involved in the design of remediation projects for contaminated sediments in ice-affected rivers.

Projected Benefits

Evaluation of ice effects on sediment processes provides two types of benefits:

- It ensures that ice processes are considered in the initial phases of the project. In a few cases, ice processes were found to govern remediation project design only after considerable time and resources had been spent on solutions that considered only open water phenomena.

- For projects where ice impacts are found to be important, an initial ice evaluation provides direction and focus for further ice-related analysis and modeling. Knowledge of ice processes, such as expected ice jam locations, severity, and frequency allows informed decisions on remediation alternatives such as capping in place, bed armoring, or removal of the contaminated sediment. This evaluation also forms a basis for the design of ice control structures to prevent ice jams and ice jam scour in contaminated sediment areas. This in turn may allow less costly solutions, e.g., capping in place rather than removal of contaminated sediments, with potential savings in the millions of dollars. Evaluations of the type described here can be accomplished quickly and at reasonable cost.

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